Damage Assessment of NiAl Single Crystal in Grinding Operations

Gregorio R. Murtagian, advisor: Steven Danyluk

Intermetallic compounds are of great importance as structural materials in gas turbine applications due to their physical and mechanical properties as high melting temperature, low density, high thermal conductivity and corrosion resistant materials. However ordered intermetallics are brittle and cannot support tensile load in many applications. Because of this brittleness, the processing of these materials must be done in such a way that cracks and other residual damage is at a minimum. Grinding is a high throughput process that would be very useful in the shaping of these intermetallics, but this process generates surface and subsurface damage. Cracks would cause catastrophic failures during component life. This work intends to define the grinding parameters with the cracking damage produced in NiAl single crystals. In order to obtain those results single point scratch tests are being performed and the results modeled by Finite Element Analysis (FEA).

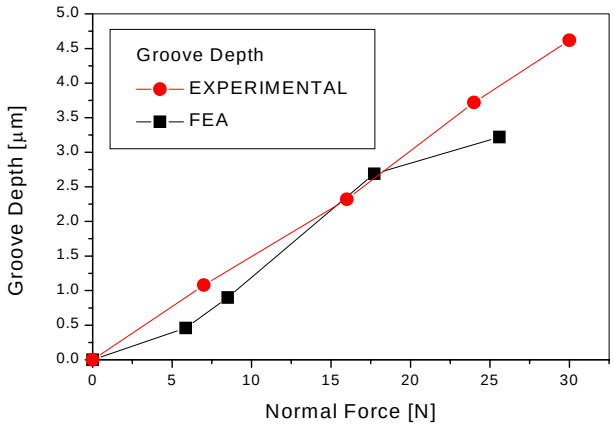

Fig. 1: Groove depth (µm) vs. normal force (N) for single point scratch tests and FEA.

Figure 1 shows some preliminary results of single crystal scratch groove depths (µm) versus normal force (N) on a 120° conical diamond and tip radius 200 µm scratching a single crystal NiAl polished sample at a velocity of 0.85mm/sec and the FEA results using a contact analysis. As can be seen, there is a linear relationship between the groove depth and normal load, and this is validated by the FEA analysis. Figure 2 shows scanning electron micrographs of the top view of four grooves scratched at 30, 24, 16 and 7N. As can be seen, cracks are present in three of the cases and absent when the load was 7N. Our research will investigate this transition load as well as other parameters in the scratching process.

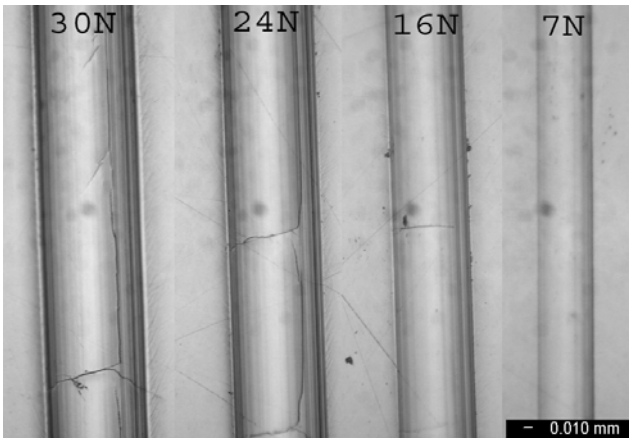

Fig. 2: SEM micrographs showing the top view of single point scratch grooves at different normal loads. Cracking is observed with loads over 7N.

Gregorio R. Murtagian *is a Ph.D candidate in the G.W.W. School of Mechanical Engineering working on research in the area of damage in grinding operations. He received his BSME degree from Universidad Tecnologica Nacional (Argentina) in 1994 and his MS Materials Science and Technology in 1997 from Unversidad de Gral San Martin (Arg.) During the 1995-1999period he had been working at various positions at the Center for Industrial Research in the areas of fracture mechanics, fatigue, tribology, mechanical design and testing.*

For more information, please contact Gregorio R. Murtagian directly at: gmurtagian@pmrc.marc.gatech.edu

To learn more about other research at Georgia Tech, please contact Scott Billington at:
scott.billington@marc.gatech.edu
Georgia Institute of Technology
Manufacturing Research Center
Phone: 404-385-0895